DECLARATION

I, Kiyoko Kono declare that:

1. I reside at c/o Saikyo Patent Office, Shikishima Building 6th Floor, 2-6, Bingomachi 3-chome, Chuo-ku, Osaka, Japan.

2. I understand and read both the Japanese and the English languages.

3. The attached is a full true and faithful English translation made by me of the priority document of the Japanese Patent Application No. 10-273244, filed on September 28, 1998.

4. I declare further that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the above-identified application or any patent issuing thereon.

Date: June 25, 2003 Name: Kiyoko Kono

Kiyoko Kono

PATENT OFFICE
JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of the following application as filed with this Office.

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Applicant : SHARP KABUSHIKI KAISHA

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[TITLE OF THE INVENTION] METHOD OF MANUFACTURING REFLECTIVE-TYPE LIQUID CRYSTAL DISPLAY APPARATUS

[NUMBER OF CLAIMS] 4

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[Item] Specification 1
[Item] Drawing(s) 1
[Item] Abstract 1
[General Power of Attorney No.] 9703283

[PROOF REQUEST] Yes

[DOCUMENT] SPECIFICATION

[TITLE OF THE INVENTION] METHOD OF MANUFACTURING REFLECTIVE-TYPE LIQUID CRYSTAL DISPLAY APPARATUS

[CLAIMS]

[Claim 1] A method of manufacturing a reflective-type liquid crystal display apparatus having, on a pair of substrates disposed so as to be opposed with a liquid crystal layer therebetween, reflecting means for reflecting incident light from the other substrate, comprising the steps of:

applying a positive photosensitive resin on one of the substrates disposed on the side of the liquid crystal layer;

exposing the positive photosensitive resin uniform and low illuminance using a first photomask;

exposing the positive photosensitive resin uniform and high illuminance using a second photomask;

developing the exposed photosensitive resin using developer solution;

heat-treating the developed photosensitive resin; and

forming a reflecting electrode on the heat-treated photosensitive resin.

[Claim 2] The method of manufacturing a reflective-type liquid crystal display apparatus of claim 1, wherein circular or polygonal light-intercepting regions are

irregularly disposed in the first photomask and that the total area of the circular or polygonal light-intercepting regions is in a range of from 20% to 40% of the total area of the photomask.

[Claim 3] The method of manufacturing a reflective-type liquid crystal display apparatus of claim 2, wherein the circular or polygonal light-intercepting regions disposed in the first photomask are irregularly disposed so that the center-to-center distances between adjoining light-intercepting regions are in a range of from 5 μm to 50 μm.

[Claim 4] The method of manufacturing a reflective-type liquid crystal display apparatus of claim 1, wherein the reflecting electrode is connected to a liquid crystal driving device, and the transmitting region of the second photomask corresponds to the contact hole for connecting the reflecting electrode with the liquid crystal driving device.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical field to which the invention belongs]

The present invention relates to a method of manufacturing a reflective-type liquid crystal display apparatus which carries out display by reflecting externally incident light.

[0002]

[Prior art]

In recent years, application of liquid crystal display apparatuses to word processors, laptop personal computers, pocket televisions and the like has rapidly been progressing. Of the liquid crystal display apparatuses, reflective-type liquid crystal display apparatuses which carry out display by reflecting externally incident light are attracting attention because the reflective-type liquid crystal display apparatuses are low in power consumption, thin and capable of being reduced in weight since no backlight is necessary.

[0003]

However, in the conventional reflective-type liquid crystal display apparatuses, the brightness and the contrast ratio of the display are dependent on the use environment such as ambient brightness or the use condition. Therefore, at present, high expectations are placed on the realization of a reflective-type liquid crystal display apparatus that has excellent reflection characteristics, can easily be manufactured with excellent reproducibility and is high in display quality.

[0004]

Japanese Unexamined Patent Publication JP-A 6-75238 discloses a technology to form random and high-density asperities on a reflecting electrode in order to improve the display quality of the reflective-type liquid crystal display

apparatus.

[0005]

According to this, a resin layer for adding fine asperities to a reflecting electrode comprises a first photosensitive resin layer patterned with random asperities and a second photosensitive resin layer for making the asperities smoother, and in a mask for patterning the first photosensitive resin layer, circular light intercepting portions are randomly disposed and the total area of the light intercepting portions is not less than 40% of the area of the reflecting plate.

[0006]

By increasing the randomness as described above, the interference due to the repetitive pattern is prevented and the reflecting light is prevented from being colored, and by increasing the density of the asperities, the area of the flat part is reduced to thereby reduce the regular reflection component.

[0007]

Moreover, Japanese Unexamined Patent Publication JP-A 9-90426 discloses a technology to simultaneously expose an asperity forming pattern and contact holes using only one layer of a positive photosensitive resin in order to reduce the process of manufacturing a reflective-type liquid crystal display apparatus.

[0008]

A method of manufacturing a reflective-type liquid crystal display apparatus described in this patent publication will briefly be described with reference to the drawings.

[0009]

Fig. 5 is a cross-sectional view showing the structure of a reflective-type liquid crystal display apparatus formed by the manufacturing method described in the above-mentioned patent publication. Fig. 6 shows cross-sectional views showing the flow of the manufacturing process.

[0010]

As shown in Fig. 5, in the reflective-type liquid crystal display apparatus described in the above-mentioned patent publication, a TFT substrate is used as a reflecting substrate 23, and the following are provided: an aluminum pixel electrode 10 disposed on the reflecting substrate 23; a transparent electrode 12 opposed thereto; a color filter substrate 25 supporting the transparent electrode 12; liquid crystal 11 sandwiched therebetween; a retardation film 15 disposed above the color filter substrate (on the side of the surface not opposed to the liquid crystal); and a polarizer 16 disposed above the retardation film 15.

[0011]

In the reflecting substrate 23, an amorphous silicon transistor is formed on a glass substrate 1 as the liquid crystal driving device 24. As shown in Fig. 5, the liquid crystal

driving device 24 comprises Ta as a gate electrode 2 on the glass substrate 1, SiNx as a insulating layer 3, a-Si as a semiconductor layer 4, n-type a-Si as an n-type semiconductor layer 5, Ti as a source electrode 7, and Ti as a drain electrode 8.

[0012]

A method of manufacturing the reflecting substrate 23 of the reflective-type liquid crystal display apparatus described in the above-mentioned patent publication will be described with reference to Fig. 6.

[0013]

First, as shown in Fig. 6(a), a positive photosensitive resin 9 is applied to the substrate 1.

[0014]

Then, as shown in Fig. 6(b), exposure is carried out at high illuminance using a photomask having transmitting portions corresponding to the contact hole and, in addition thereto, transmitting portions as shown in Fig. 7.

[0015]

Then, as shown in Fig. 6(c), by development with a developing solution, the resin in the exposed parts mentioned above is completely removed, so that a resin configuration that is positive with respect to the mask pattern is formed.

[0016]

Then, as shown in Fig. 6(d), by a heat treatment, the

resin in the exposed regions is deformed into smooth asperities. However, at this time the exposed regions are flat because the resin has completely been removed by the above-described developing step.

[0017]

Then, as shown in Fig. 6(e), an Al thin film is formed as the reflecting electrode 10, and patterning is performed so that one reflecting electrode 10 corresponds to one transistor.

[0018]

The reflecting electrode 10 of the reflective-type liquid crystal display apparatus described in the above-mentioned patent publication is formed by the above-described process. In such a reflecting substrate 23, since the positive photosensitive resin in the exposed portions has been completely removed, the area of the flat part is large. In such a reflecting plate in which the area of the flat part is large, since the light source is reflected in the flat region, the regular reflection component is large. Since display is difficult to confirm when the light source is reflected, the regular reflection component generally is avoided in the case of the reflective-type display apparatus.

[0019]

Therefore, the regular reflection component of the reflecting plate in the reflective-type liquid crystal display apparatus disclosed in the above-mentioned patent publication

do not contribute to the brightness, which results in dark display.

[0020]

[Problems that the invention is to solve]

Compared to the reflective-type liquid crystal display apparatus disclosed in JP-A 9-90426, previously-mentioned JP-A 6-75238 discloses a reflective-type liquid crystal display apparatus adopting a complicated asperity forming process in order to create an ideal scattering condition by improving the density of the asperities of the reflecting plate. According to this apparatus, after application of a first positive photosensitive resin, first exposure development of a sufficient intensity is performed. Then, after the patterning of the asperities are completely performed, the clearances of the asperities are completely filled so that the asperities are smooth. Then, a second positive photosensitive resin is applied in order to reduce the area of the flat part, and thereafter, only the patterning of the contact hole portions is again performed by performing second exposure development.

[0021]

However, in this process, since the photosensitive resin is applied in two layers, it is necessary to perform the photoprocess (application - exposure - development - heat treatment) of the photosensitive resin twice, so that the cost clearly increases.

[0022]

Further, in the reflective-type liquid crystal display apparatus disclosed in JP-A 9-90426, since one layer of a positive photosensitive resin is used, it is necessary to perform the photoprocess of the photosensitive resin only once, so that the process is simplified and cost reduction can be achieved. However, since it is necessary to remove certainly the photosensitive resin in the contact hole portions, it is inevitable that the positive photosensitive resin in the exposed area in the asperity forming pattern portion is also removed. Consequently, the exposed area is flat, so that in the reflecting plate, the density of the asperities is low and the regular reflection component is large.

[0023]

The invention is made to solve the above-mentioned problems of the reflective-type liquid crystal display apparatus, and an object thereof is to provide a method of manufacturing a liquid crystal display apparatus with which a reflecting plate having excellent reflection characteristics can easily be manufactured with excellent reproducibility, whereby the display quality is improved.

[0024]

[Means of solving the problems]

In order to achieve the above-mentioned object, the invention provides a method of manufacturing a reflective-type

liquid crystal display apparatus having, on a pair of substrates disposed so as to be opposed with a liquid crystal layer therebetween, reflecting means for reflecting incident light from the other substrate, comprising the steps of:

applying a positive photosensitive resin on one of the substrates disposed on the side of the liquid crystal layer;

exposing the positive photosensitive resin uniform and low illuminance using a first photomask;

exposing the positive photosensitive resin uniform and high illuminance using a second photomask;

developing the exposed photosensitive resin using developer solution;

heat-treating the developed photosensitive resin; and

forming a reflecting electrode on the heat-treated photosensitive resin.

[0025]

Further, it is preferable that circular or polygonal light-intercepting regions are irregularly disposed in the first photomask and that the total area of the circular or polygonal light-intercepting regions is in a range of from 20% to 40% of the total area of the photomask.

[0026]

Furthermore, it is also preferable that the circular or polygonal light-intercepting regions disposed in the first photomask are irregularly disposed so that the center-to-center

distances between adjoining light-intercepting regions are in a range of from 5 μm to 50 μm.

[0027]

Still more, it is also preferable that the reflecting electrode is connected to a liquid crystal driving device, and the transmitting region of the second photomask corresponds to the contact hole for connecting the reflecting electrode with the liquid crystal driving device.

[0028]

Now, descriptions over how the method of manufacturing a liquid crystal display apparatus of the invention works are given below.

[0029]

According to the invention, by exposing one layer of a photosensitive resin applied to the substrate with the exposure of both of a low-illuminance and a high-illuminance on an area basis, smooth and high-density asperities can be formed, so that ideal reflecting means with a reduced flat area and a small regular reflection component can be formed. Consequently, the number of photoprocesses of the photosensitive resin can be reduced to thereby reduce the cost necessary for the manufacture.

[0030]

At the exposing step, since the positive photosensitive resin in the part intercepted from light by a photomask (light

intercepted region) is not readily soluble in a developing solution, circular or polygonal pillars are formed, and since the positive photosensitive resin in the part not intercepted from light by the photomask (transmitting region) is readily soluble in the developing solution, a photosensitive resin film having asperities is formed on the substrate in correspondence with the transmitting region and the light intercepted region of the photomask by developing the photosensitive resin with the developing solution after the exposure.

[0031]

In the invention, exposure at the steps of exposing the photosensitive resin is performed with both high and low illuminance. Here, the high-illuminance exposure indicates an exposure performed with an exposure amount where a sensitizer that restrains the dissolution of the resin in the developing solution is made sufficiently soluble in the positive photosensitive resin and the left film amount after the development is substantially 0%, and the low-illuminance exposure indicates an exposure performed with an exposure amount where the solubilization of the sensitizer that restrains the dissolution of the resin in the developing solution is not sufficiently performed in the positive photosensitive resin and the left film amount after the development is 0% or more and less than 50% of the film thickness before the development.

[0032]

More specifically, with the use of the method of manufacturing the reflective-type liquid crystal according to claim 1, in the positive photosensitive resin formed on the substrate, owing to the low-illuminance exposure with the first photomask, the sensitizer in the part subjected to the exposure of a low illuminance with the first photomask is not sufficiently solubilized, so that the film of the part subjected to the low-illuminance exposure is uniformly reduced in thickness by the development with the developing solution after the exposure.

[0033]

Moreover, in the positive photosensitive resin formed on the substrate, owing to the high-illuminance exposure with the second photomask, the sensitizer in the part subject to the exposure of a high illuminance using the second photomask is sufficiently solubilized, so that the photosensitive resin on the substrate is completely removed by the development with the developing solution after the exposure. This enables the connection between the reflecting electrode formed at a succeeding step and a TFT drain electrode.

[0034]

As described above, owing to the high-illuminance exposure, the low-illuminance exposure and development on one layer of a positive photosensitive resin and heat-treatment of

the photosensitive resin, the asperities of the photosensitive resin formed on the substrate are deformed by heat, with the result that continuous, high-density and smooth asperities without any flat part are formed on the substrate.

[0035]

Further, by forming the reflecting electrode on the heat-treated photosensitive resin having the smooth asperities, excellent reflecting means with a small regular reflection component can be formed.

[0036]

In the invention, the order of the steps of the low-illuminance exposure and the high-illuminance exposure may be opposite to the above-described order.

[0037]

As the process from the exposing step to the developing step, the following two are considered: the process from exposure (the low-illuminance exposure and the high-illuminance exposure) to development; and the process from exposure (the low-illuminance exposure or the high-illuminance exposure) through development and exposure (the high-illuminance exposure or the low-illuminance exposure) to development. In the invention, either of the two processes can be used. However, the former process is preferable in view of the simplification of the process.

[0038]

Further, with the use of the method of manufacturing the reflective-type liquid crystal according to claim 2, since the circular or polygonal light-intercepting regions are irregularly disposed in the above-mentioned first photomask, the periodicity of the pattern of the asperities of the photosensitive resin formed on the substrate is eliminated, so that the light interference phenomenon can be prevented. As a result, white scattered light without any color can be obtained. Moreover, since the scattered light from the asperities does not biased in a specific direction, uniform scattered light can be obtained.

[0039]

Since the total area of the circular or polygonal light-intercepting regions in the first photomask is in a range of from 20% to 40% of the photomask, the angle of inclination of the asperities of the photosensitive resin formed on the substrate can be controlled so that the light can efficiently be used.

[0040]

Here, in the case where the area of the light-intercepting regions in the first photomask is not less than 40%, when the light-intercepting regions are randomly disposed, adjoining light-intercepting regions (circular or polygonal regions) overlap each other into a large pattern, so that the pattern density decreases as a whole and the ratio of the area

of the flat part increases. As a result, a reflecting plate with a large regular reflection component is formed. In the case where the area of the light-intercepting regions in the first photomask is not more than 20%, when the light-intercepting regions are randomly disposed, the distances between adjoining light-intercepting regions (circular or polygonal regions) are too large, so that the distances between convex portions and convex portions of the configuration of the photosensitive resin formed by development are too large and flat parts are left between convex portions when the resin is deformed by heating. As a result, a reflecting plate with a large regular reflection component is formed. From these, in the invention, the total area of the light-intercepting regions in the first photomask is in a range of from 20% to 40% of the total area of the photomask.

[0041]

With the use of the method of manufacturing the reflective-type liquid crystal according to claim 3, by irregularly disposing the light-intercepting regions disposed in the first photomask so that the center-to-center distances between adjoining light-intercepting regions are in a range of from 5 μm to 50 μm, a sufficient number of asperity patterns can be disposed for one picture element of the reflective-type liquid crystal display apparatus, so that scattered light can be obtained in which there is no difference in characteristics

between picture elements.

[0042]

In the case where adjoining light-intercepting regions are disposed so as not to overlap each other, patterns in which the center-to-center distance is not more than 5 μm are not resolved but become flat because of the limit of resolution of the exposure machine, so that a reflecting plate with a large regular reflection component is formed. Generally, in a liquid crystal display apparatus, since the size of one picture element is not more than approximately 100 μm $\times$ 300 μm, to dispose approximately ten or more convex portions for one picture element in order to obtain uniform scattering property, it is necessary that the center-to-center distance is substantially not more than 50 μm. When the center-to-center distance is equal to or larger than 50 μm, since the distances between the light-intercepting regions are large, the ratio of the area of the flat part increases, so that a reflecting plate with a large regular reflection component is formed. From these, in the invention, the light-intercepting regions disposed in the first photomask are irregularly disposed so that the center-to-center distances between adjoining light-intercepting regions are in a range of from 5 μm to 50 μm.

[0043]

Further, with the use of the method of manufacturing the reflective-type liquid crystal according to claim 4, owing to

the formation of transmitting region on the second photomask, which corresponds to the contact hole for connecting a reflecting electrode with a liquid crystal driving device, the photosensitive resin is left over the entire display picture element region except the contact holes, so that asperities in which the area of the flat part is small and which is smooth over the entire picture element region can be formed. As a result, a reduced regular reflection can be realized, thereby obtaining a brighter reflected light.

[0044]

[Working examples]

Now referring to the drawings, a reflective-type liquid crystal display apparatus of an embodiment of the invention is described below. Fig. 1 is a cross-sectional view showing a reflective-type liquid crystal display apparatus according to an embodiment of the invention. Fig. 2 shows cross-sectional views showing the flow of the manufacturing process of the substrate.

[0045]

In this embodiment, the below-described explanation is made in account of the conventional reflective-type liquid crystal display apparatus disclosed in JP-A 9-90426. The reflective-type liquid crystal display apparatus of this embodiment has the following general construction.

[0046]

As shown in Fig. 1, in the reflective-type liquid crystal display apparatus described in the above-mentioned patent publication, a TFT substrate is used as a reflecting substrate 23, and the following are provided: an aluminum pixel electrode 10 disposed on the reflecting substrate 23; a transparent electrode 12 opposed thereto; a color filter substrate 25 supporting the transparent electrode 12; liquid crystal 11 sandwiched therebetween; a retardation film 15 disposed above the color filter substrate (on the side of the surface not opposed to the liquid crystal); and a polarizer 16 disposed above the retardation film 15.

[0047]

In the reflecting substrate 23, an amorphous silicon transistor is formed on a glass substrate 1 as the liquid crystal driving device 24. As shown in Fig. 1, the liquid crystal driving device 24 comprises Ta as a gate electrode 2 on the glass substrate 1, SiNx as a insulating layer 3, a-Si as a semiconductor layer 4, n-type a-Si as an n-type semiconductor layer 5, Ti as a source electrode 7, and Ti as a drain electrode 8.

[0048]

A signal input terminal portion 27 for inputting signals to a gate bus line and a source bus line comprises a Ta portion and an ITO portion, both of which are formed by patterning simultaneously with the gate bus line.

[0049]

A manufacturing process of the reflecting substrate 23 of the reflective-type liquid crystal display apparatus according to this embodiment will be described with reference to Fig. 2.

[0050]

First, as shown in Fig. 2(a), a positive photosensitive resin 9 (the name of the product: OFPR-800 manufactured by Tokyo Ohka Kogyo Co., Ltd.) is applied to the substrate 1 in a thickness of 1 to 5 μm. In this embodiment, the resin 9 was applied in a thickness of 3 μm.

[0051]

Then, by using a first photomask in which the area of light intercepting portions 17 was in a range of from 20% to 40% as shown in Fig. 3, exposure was uniformly performed at a low illuminance as shown in Fig. 2(b). It is desirable that the exposure amount at this time is 20 mj to 100 mj. In this embodiment, exposure was performed with an exposure amount of 40 mj, using a first photomask in which the area of light intercepting portions 17 was 30%. At this time, the circular or polygonal light intercepting portions 17 of the first photomask 19 were randomly disposed so that the center-to-center distances between adjoining circular or polygonal light intercepting portions 17 were in a range of from 5 μm to 50 μm, preferably, 10 μm to 20 μm.

[0052]

Then, by using a second photomask in which the contact hole portions 18 were opened as shown in Fig. 4, the contact hole portions were uniformly exposed at a high illuminance as shown in Fig. 2(c). At this time, the second photomask also serves as a transmitting portion with respect to the signal input terminal portion 27, and the terminal portion 27 was exposed at a high illuminance simultaneously with the exposure of the contact holes. It is desirable that the exposure amount at this time is 160 mj to 500 mj. In this embodiment, exposure was performed with an exposure amount of 240 mj.

[0053]

Then, as shown in Fig. 2(d), by performing development with a developing solution TMAH (tetramethylammoniumhydrooxide) manufactured by Tokyo Ohka Kogyo Co., Ltd., the above-mentioned resin in the part exposed to a high illuminance (the contact hole portions and the signal input terminal portion) was completely removed, approximately 40%, with respect to the initial film thickness, of the resin in the part exposed at a low illuminance was left, and approximately 80%, with respect to the initial film thickness, of the resin in the unexposed part was left.

[0054]

Then, as shown in Fig. 2(e), by performing a heat treatment at 200℃ for 60 minutes, the resin of the above-

described condition was deformed into smooth asperities.

[0055]

Then, as shown in Fig. 2(f), an Al thin film was formed by sputtering as the reflecting electrode 10 in a thickness of 2000 Å, and as shown in Figs. 2(g) to (k), patterning was performed so that one reflecting electrode 10 corresponds to one transistor.

[0056]

Specifically, the photoresist 28 was applied as shown in Fig. 2(g), the terminal portion 27 and a portion to be removed were exposed as shown in Fig. 2(h), and development, etching and exfoliation were performed as shown in Figs. 2(i) to (k) to thereby perform patterning of the Al electrode.

[0057]

In the embodiment according to the invention, by the above-described process, the reflecting plate having smooth and high-density asperities was formed. In such a reflecting plate 23, the area of the flat part is reduced, so that ideal reflecting plate having a small regular reflection component can be formed. Moreover, the number of photoprocesses of the photosensitive resin can be reduced, so that the cost necessary for the manufacture of the reflecting plate can be reduced.

[0058]

[Effect of the invention]

According to the invention, by exposing one layer of a

photosensitive resin applied to the substrate with the exposure of both of a low-illuminance and a high-illuminance on an area basis, smooth and high-density asperities can be formed, so that ideal reflecting means with a reduced flat area and a small regular reflection component can be formed. Consequently, the number of photoprocesses of the photosensitive resin can be reduced to thereby reduce the cost necessary for the manufacture.

[0059]

In the invention, since a positive photosensitive resin is used, when the low-illuminance exposure is performed with the photomask, the reaction of initiator progresses from the surface of the photosensitive resin, so that dissolution readily progresses from the surface when the reacting portion is dissolved by the development, and in the case where it is necessary to control the film reduction amount like in the invention, the control can easily be performed.

[BRIEF EXPLANATION OF THE DRAWINGS]

[Fig. 1]

Fig. 1 is a cross-sectional view of the reflective-type liquid crystal display apparatus formed by the method of manufacturing a reflective-type liquid crystal display apparatus according to an embodiment of the invention.

[Fig. 2]

Figs. 2(a) to (f) are cross-sectional views showing a manufacturing process of the reflecting substrate used in the reflective-type liquid crystal display apparatus according to an embodiment of the invention.

[Fig. 3]

Fig. 3 is a schematic plan view showing the patterns of a transmitting region and light intercepting region of a first photomask according to an embodiment of the invention.

[Fig. 4]

Fig. 4 is a schematic plan view showing the patterns of transmitting region and a light intercepting region of a second photomask according to an embodiment of the invention.

[Fig. 5]

Fig. 5 is a cross-sectional view showing the reflective-type liquid crystal display apparatus formed by the conventional manufacturing method.

[Fig. 6]

Figs. 6(a) to (e) are cross-sectional views showing the manufacturing process of the reflecting substrate in the conventional reflective-type liquid crystal display apparatus.

[Fig. 7]

Fig. 7 is a schematic plan view showing the patterns of the transmitting regions and the light intercepting region of the conventional photomask.

[Reference numerals]

1	glass substrate on the TFT side
2	gate bus line (Ta)
3	gate insulating film (SiNx)
4	semiconductor layer (a-Si)
5	n-type semiconductor layer (n-type a-Si)
6	etch stopper
7	source electrode
8	drain electrode
9	insulating layer between layers (positive photosensitive resin)
10	reflecting electrode
11	liquid crystal layer
12	ITO electrode
13	color filter
14	glass plate on the side of color filter
15	retardation film
16	polarizer
17	light intercepting portion
18	transmitting portion
19	first photomask
20	second photomask
21	photomask
22	UV light
23	reflecting substrate
24	liquid crystal driving device

25 color filter substrate

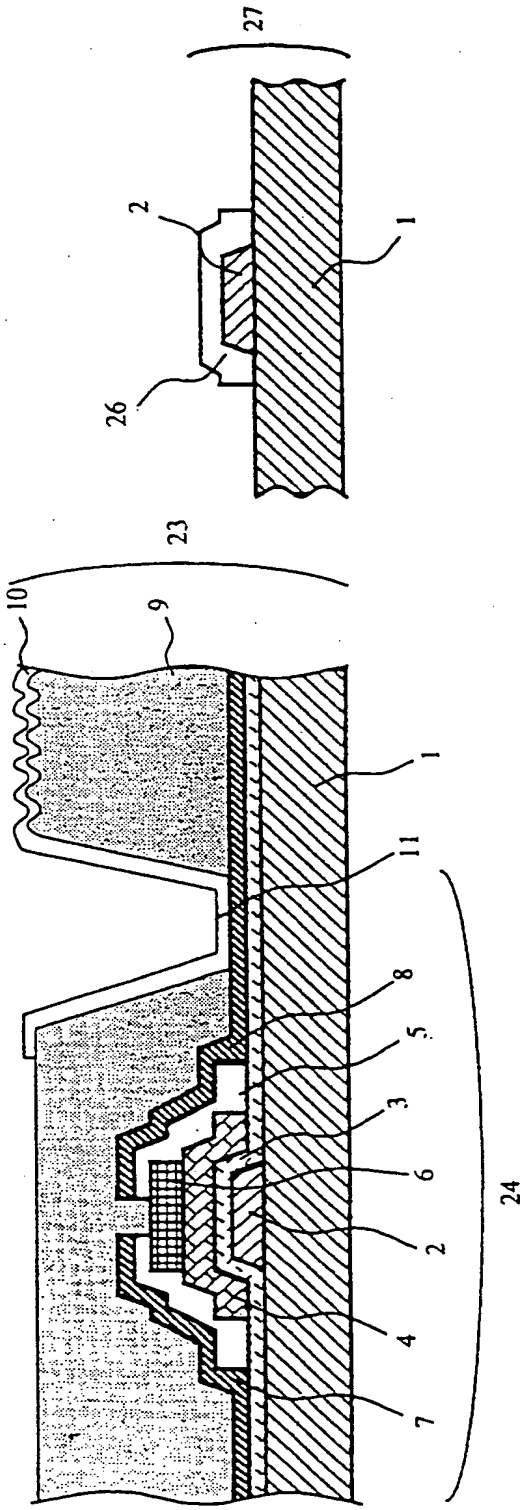
26 terminal ITO electrode

27 signal input terminal portion

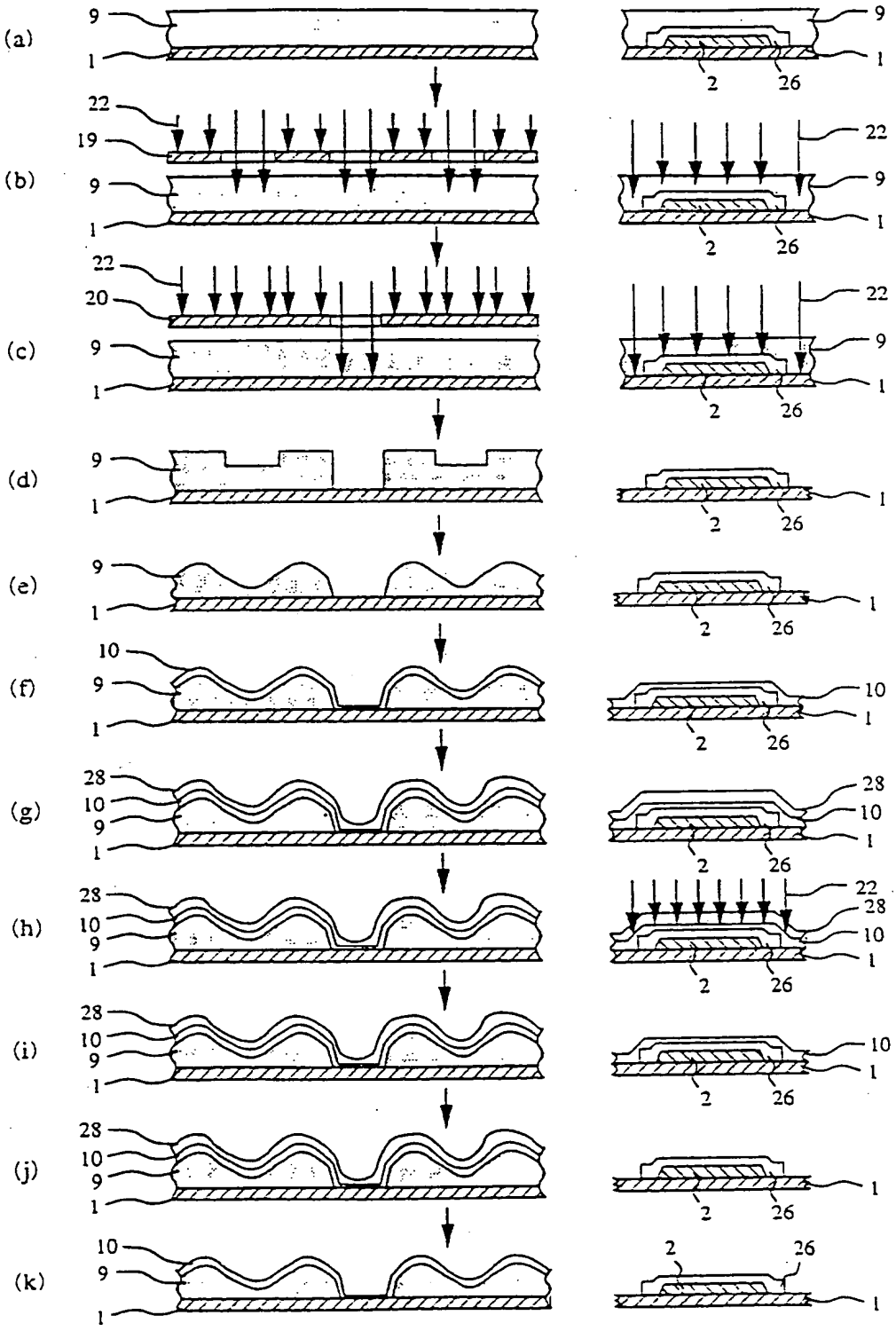
28 photoresist

[DOCUMENT] DRAWINGS

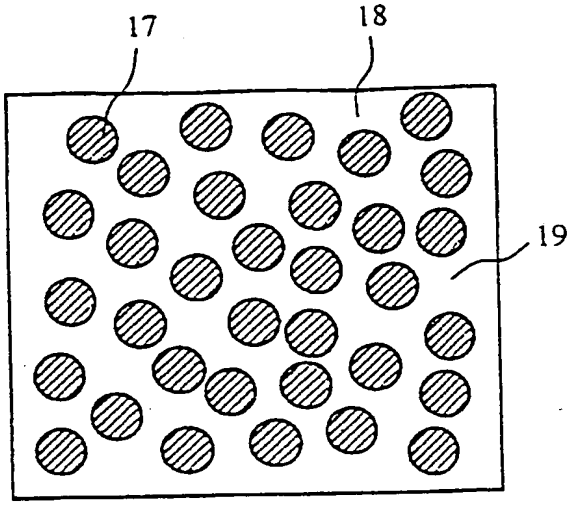
[Fig. 1]



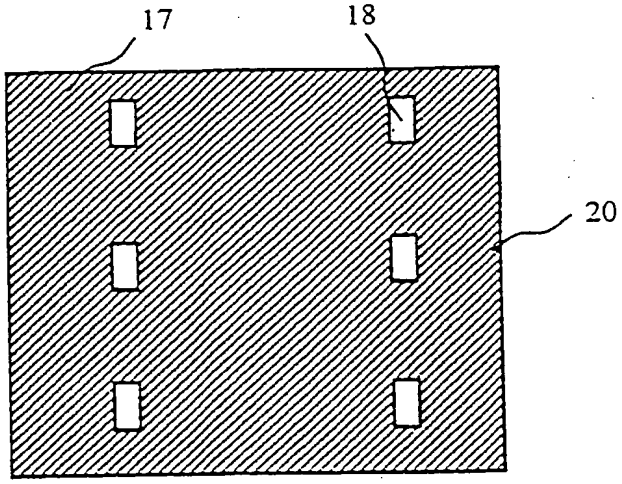
[Fig. 2]



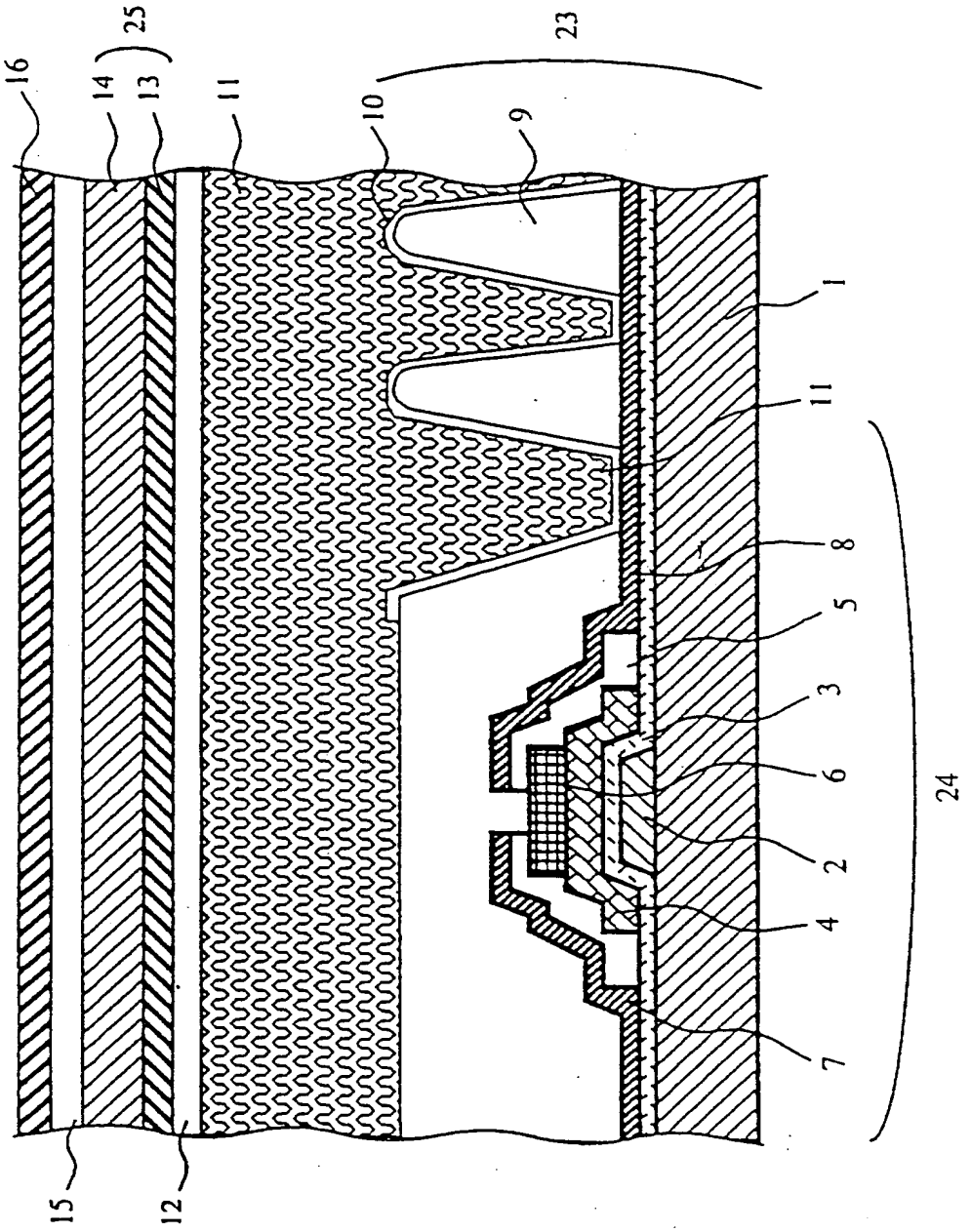
[Fig. 3]



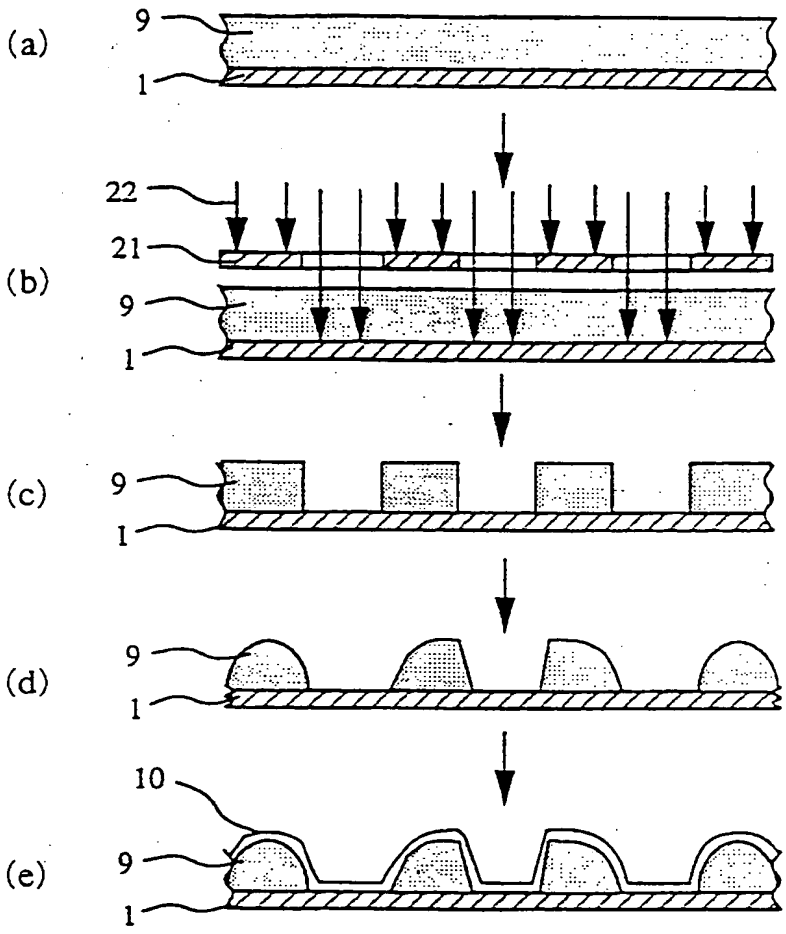
[Fig. 4]



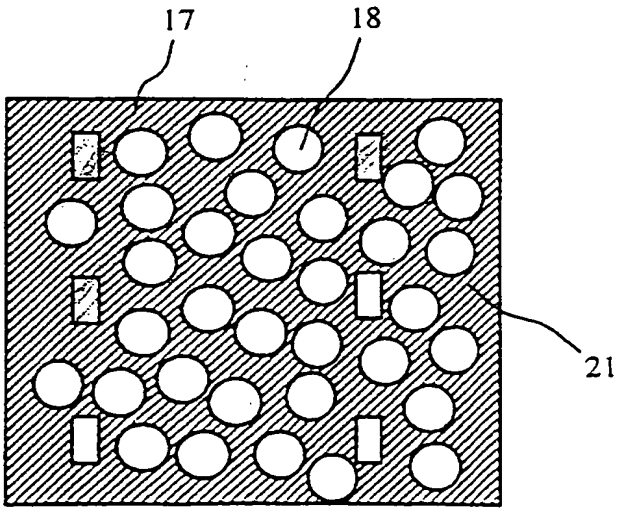
[Fig. 5]



[Fig. 6]



[Fig. 7]



[DOCUMENT] ABSTRACT

[ABSTRACT]

[OBJECT] An object of the invention is to provide a method of manufacturing a liquid crystal display apparatus of high display quality by which a reflecting plate having excellent reflection characteristics can easily be manufactured with excellent reproducibility.

[SOLUTION] In a method of manufacturing a reflective-type liquid crystal display apparatus having, on a pair of substrates disposed so as to be opposed with a liquid crystal layer therebetween, reflecting means for reflecting incident light from the other substrate, the method includes the steps of applying a positive photosensitive resin on one of the substrates disposed on the side of the liquid crystal layer, exposing the positive photosensitive resin uniform and low illuminance using a first photomask, exposing the positive photosensitive resin uniform and high illuminance using a second photomask, developing the exposed photosensitive resin using developer solution, heat-treating the developed photosensitive resin, and forming a reflecting electrode on the heat-treated photosensitive resin.

[FIGURE TO BE PUBLISHED] Fig. 2